# Chilliwack Forest District

## Inventory Plan

MINISTRY OF FORESTS
RESOURCES INVENTORY BRANCH
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# 1. INTRODUCTION

## 1.1 Background

The Provincial Vegetation Resources Inventory (VRI) or Provincial Inventory is an improved vegetation (forest) inventory process or toolbox for assessing the quantity and quality of British Columbia's timber and other vegetation resources. It addresses the concerns expressed by the Forest Resources Commission in its 1991 report, *The Future of our Forests*. These concerns included:

- lack of statements of precision of the inventory;
- inadequate information on non-timber vegetation resources;
- lack of reliable estimates of growth rates and stand specific volumes; and
- narrow focus on commercial timber volume and the timber harvesting landbase.

The VRI can be implemented at a number of levels depending on the business needs. It can be deployed over the entire province (one or more Forest District at a time), measuring all the timber and non-timber resources. The VRI can also be deployed over a Management Unit (TFL or TSA) or a small watershed within a District, measuring selected resources in specific portions of the landbase.

The Provincial Inventory consists of a system of protocols, models and databases that can be managed through a dispersed computing environment. The Provincial Inventory process can be used to meet today's needs for timber supply, long term planning, silviculture planning, defining sustainability, public information and credibility. The Provincial Inventory can also provide data for computer modeling and decision support systems to support a baseline biodiversity assessment and for research.

The Vegetation Resources Inventory is designed to determine:

- the amount of vegetation cover in the province;
- the location of vegetation resources in the province; and
- the changes in the amount and location of vegetation resource over time.

The principles guiding the implementation of the inventory are:

- to integrate provincial inventory activities (e.g. Management Inventories, Provincial Inventory, National Forest Inventory and Monitoring);
- to implement inventory projects to satisfy business requirements as defined in the inventory plans; and
- to maximize the usefulness of sample plots and minimize overall costs by implementing a cascading plot approach that ensures that information collection meets the VRI standards while meeting multiple goals.

Management Inventories include inventories conducted in Implementation Units[1], to fulfill specific forest management or business needs. Sampling error and sampling intensity are controlled for specific vegetation attributes (e.g., timber volume) to achieve specific inventory objectives. There are several types of Implementation Units in the province: Timber Supply Areas (TSAs), Tree Farm Licenses (TFLs), and other lands (parks, private lands, and other public lands). Within (or across) these Implementation Units there may be Management Inventories addressing specific issues such as Problem Forest Types, or other strata in a TSA (or groups of TSAs).

Management Inventories are typically timber emphasis inventories. Besides providing detailed polygon information for day-to-day forest management, they can also be used to increase precision of the Provincial Inventory. The TFL holders or the MoF Regions/Districts are responsible for the planning and implementation of these inventories. However, the Ministry of Forests Resources Inventory Branch requires the TFL holder(s), stakeholder(s), or District(s) to prepare an inventory business plan, which includes a sampling plan, for its approval. An inventory business plan defines the inventory needs, the information needed to meet the needs, and the methods for collecting the information. This business plan then drives the inventory project plans.

## 1.2 Objectives

This is a plan for implementing the Provincial and Management Inventory activities in the Chilliwack Forest District in the Vancouver Forest Region. This plan was developed through consultation with various stakeholders during April 1997 in the Chilliwack Forest District, including the Ministry of Forests, Branch, Region and District staff, and Canadian Forest Products (TFL 48) staff who identified inventory local needs and priorities. Management issues identified in the recent timber supply review in the TSA were also reviewed.

The purpose of the Inventory Plan is to:

1. define the Management Inventory objectives;
2. define the Provincial Inventory strategy for Chilliwack Forest District;
3. identify the inventory activities required to satisfy the objectives for both inventories; and
4. outline the implementation steps.

This plan is based on the consultant report, *Chilliwack Forest District Vegetation Resources Inventory Ground Sampling Plan, Revised Final Report*, prepared by J.S. Thrower & Associates. The report was prepared following the procedures outlined in the Ministry of Forests, Resources Inventory Branch procedures, *Vegetation Resources Inventory: Preparing a sampling plan for ground sampling* (March 1997). The report has

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[1] Implementation Units are a specified area of land such as a TSA, TFL, Innovative Forest Practices Agreement area, etc. For any Implementation Unit, there can be none to several Management Inventories based on stakeholder business needs.

been reviewed by stakeholders in the District and is attached to this Inventory Plan (Appendix A).

# 2. BUSINESS CONSIDERATIONS

## 2.1 Forest Management Issues

Forest management issues were identified during the recent timber supply reviews (Table 1). An assessment of potential impacts of the VRI ground sampling on these management issues is also shown in these tables.

Table 1. Forest management issues for the Chilliwack Forest District and the potential impact for the VRI.

| | Issue[2] | Remarks |
|---|---|---|
| | *Fraser TSA* | |
| 1. | Preliminary inventory audit: BCFS analysis may have overestimated existing mature volumes. | The inventory audit showed that mature volumes were over-stated in the operable landbase. Phase II will lead to improved District net volumes by removing this overall bias through statistical adjustment. Statistical statements of accuracy for the overall inventory will be provided. |
| 2. | Temporary AAC reduction associated with spotted owl management and protected area study areas. | Application of the Inventory. |
| 3. | Visually sensitive areas: District staff should encourage licensees to harvest the permissible volumes in these areas. | Application of the Inventory. |
| 4. | Minimum harvestable ages: assess feasibility of changes to minimum age. | An improved database may allow for the feasibility of assessing changes to minimum age. |
| 5. | Land and Resource Management Plan should be encouraged to commence early. | Better information will be attained from Phase I (mostly complete), and will be obtained from Phase II. |
| 6. | Selection harvesting opportunities in visually sensitive areas: the impact of these practices will require assessment. | Application of the Inventory. |
| 7. | Green-up periods: harvest forecast in the short-term (first 30-50 years) is affected by the estimated time that it takes regenerated stands to reach required green-up height. | Phase II will provide an overall TSA proportion of regenerated areas that are below a specified green-up height threshold. Special inventories will be required for this purpose. |

[2] BC Ministry of Forests. Timber Supply Branch. 1996. Forest Management Issues identified through the AAC Determination Process. TSA/TFL Timber Supply Reviews: 1992-1996. 31 December 1996. Victoria BC. Pages 187-190; 301-302; 308-313.

| | Issue[2] | Remarks |
|---|---|---|
| 8. | Deer winter range. | Plant lists, lichen production, forage production, and shrub transects from Phase II plots provide TSA totals, which could be used to confirm base interpretations for wildlife. Improved Phase I estimates provide additional information on delineating wildlife habitat and protected areas. |
| 9. | Areas with special recreational value. | Application of the Inventory. |
| 10 | Plan for the encroachment of urbanization in the Chilliwack & Mission areas on the productive forest because of strong Lower-Mainland population growth and higher housing prices in more westerly communities. | Application of the Inventory. |
| 11 | Plan for more forest recreation areas in response to strong population growth. | Application of the Inventory. |
| 12 | Develop an improved understanding of the economic trade-offs between long and short rotation cycles for lower quality second-growth stands. | The second-growth stand inventory is weak, therefore any enhancement of information through Phase II sampling would be helpful. |
| *TFL 43* | | |
| 13 | Biodiversity: forest, landscape, stand, and genetic-level biodiversity measures need to be incorporated into the next analysis. | Plant lists, forage production, and shrub transects from Phase II plots provide District totals, which could be used to confirm base interpretations for wildlife and biodiversity. The new Phase I estimates provide additional information on delineating wildlife habitat and protected areas. |
| 14 | Clarify the amount of environmentally sensitive areas (ESAs). | Phase II will provide an overall District proportion of ESAs. However, this issue is addressed by the new Phase I estimates. In any case, the MOF is moving away from classifying areas as ESAs in favor of describing the physical attributes of these areas. |
| 15 | Existing cottonwood stands: develop stand yield data. | Application of the Inventory. |
| 16 | Managed cottonwood stands: refine site index estimates to determine site productivity. | Site index measurements from Phase II plots can be used to help check the site index estimates in the current inventory database for refinement purposes. |
| 17 | Decay, waste, and breakage: quantify factors for cottonwood stands. | Phase II data will provide information on decay. Estimates of waste and breakage are not available. |
| 18 | Minimum harvestable ages: refine data regarding minimum harvestable ages for cottonwood stands. | An improved database may allow for the refinement of data regarding minimum ages. |

| | Issue[2] | Remarks |
|---|---|---|
| 19 | Inventory audit will be completed as part of the provincial inventory audit program. | Application of the Inventory. |
| 20 | Forest cover update is required for review before the next analysis. | Phase I data provides the necessary forest cover update for the next analysis. |
| 21 | Identification of VQOs is required for the next analysis. | Application of the Inventory. |
| 22 | Erosion and accretion activity from rivers: quantify landbase losses due to these factors. | Application of the Inventory. |
| 23 | Schedule B prorate: licensee must submit proposed and current prorate for Schedule B lands. | Application of the Inventory. |
| 24 | Regeneration delay: monitor regeneration performance. | Application of the Inventory. |
| 25 | Alternative silviculture systems: document any plans to use selection harvesting in the next management plan. | Application of the Inventory. |
| 26 | Volume-based analysis required for the Lower Fraser Block of TFL 43. | Volume-based information will be available for analysis purposes. |
| 27 | Regenerated stand volumes: advise when volume-based timber supply analyses will be feasible. | Application of the Inventory. |
| 28 | Fertilization: quantify effects on cottonwood stands. | Application of the Inventory. |
| 29 | Traditional use. | Plant lists from Phase II will provide incidence data for medicinal plants and other botanical products as a basis for additional sampling. |
| 30 | Operability: review any inclusions of currently inoperable land. | Application of the Inventory. |
| 31 | Riparian areas: preliminary review of stream classifications (based on FPC riparian requirements) suggests a reduction of one percent of the timber harvesting landbase. | Phase I may provide some riparian information. |
| 32 | Existing volumes: monitor and compare harvest volumes with inventory predictions. | Phase II plots will provide data to check existing volumes. However, the number of timber emphasis plots must be increased to confirm conclusions from the Phase II plots. |

| | Issue[2] | Remarks |
|---|---|---|
| 33 | OAFs: Licensee is expected to re-examine OAFs as currently applied in the analysis for Douglas-fir plantations. | Application of the Inventory. |
| 34 | Unsalvaged losses: past records indicate there are no unsalvaged losses as a result of catastrophic occurrences of fire, insects, or disease; this must be reconfirmed. | Data on insect, disease, and root rot is collected during the Phase II sampling. |
| 35 | Managed and unmanaged second-growth stands (<120 years): there is little up-to-date data on second-growth stands in the TFL. | Phase I is mostly complete. It is an enhancement of the existing database, which adds any attribute information (VRI standard) which does not already exist.<br>Measurements from Phase II plots can be used to check existing site index estimates. However, this data will not address the issue of potential site index and productivity applicable to managed stands. |
| 36 | Confirmed partition Deciduous cut ($3,000m^3$/yr): more data is required on the Deciduous component of the TFL. | Application of the Inventory. |

## 2.2 Inventory Issues

The most recent Timber Supply Reviews in the TSA and TFLs and the Inventory Audit in the TSA identified specific issues and information to improve the inventory. Some of the specific issues and information identified by Ministry of Forests Region and District staff and Canadian Forest Products Ltd. staff include:

- Accuracy of timber volumes in the timber harvesting landbase of the TSA, TFL 26, and TFL 43.
- Green-up estimation. This is a monitoring issue.
- Estimation of cottonwood yields and site productivity in TFL 43.
- Decay, waste, and breakage estimates for cottonwood in TFL 43.
- Quality of second-growth stands in TFL 26 and the TSA.
- Identification and volume estimate of deciduous stands in TFL 26.
- Wildlife capabilities, e.g., ungulates and grizzlies.
- Ecological description of lesser species.
- Spotted owl inventory. This inventory issue is being addressed through a separate inventory process.
- Database and boundaries. Different databases exist for the Fraser TSA, the TFLs, and the GVWD.

- Stratify inventory by Analysis Units (species and site class) or by Landscape Units (geographic areas) for Timber Supply Analysis.
- Information for resource management planning for BC Parks (e.g., fire management and pest management).
- Provincial and District monitoring of the criteria and indicators of sustainable forest management defined by the Canadian Council of Forest Ministers (CCFM).[3] Monitoring would involve measuring changes and trends in some of these indicators, which include percent and extent of area by forest type and age class, and mean annual increment by forest type and age class.
- Issues raised by the Forest Resources Commission's 1991 report, *The Future of Our Forests*, regarding the inadequacy of forest inventories in the province. These concerns included lack of statements of precision on the inventory, inadequate information on non-timber vegetation, and the narrow focus on commercial timber volume and the operable landbase.

# 3. INVENTORY PLAN

## 3.1 Provincial Inventory

### 3.1.1 Provincial Inventory Landbase

The landbase for the Chilliwack VRI is the Chilliwack Forest District, which includes the Fraser Timber Supply Area (TSA), TFLs, private land, and Parks. The District covers an area of 1,553,537 ha. About 22% of the Fraser TSA landbase was considered available for timber harvesting in the 1993 Timber Supply Analysis.

### 3.1.2 Objectives

#### *3.1.2.1 Photo Interpretation*

Photo interpretation work has been considered but is not recommended for the Chilliwack Provincial Inventory.

#### *3.1.2.2 Ground Sampling*

The objective of the Provincial Inventory ground sampling in the Chilliwack Forest District is to provide overall totals and averages for timber and non-timber vegetation resources. The Provincial Inventory ground sampling will aim to achieve a sampling error of $\pm$10% (at the 95% probability level) for net timber volume in the treed portion of the

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[3] Canadian Council of Forest Ministers. 1995. Defining Sustainable Forest Management. A Canadian approach to criteria and indicators. Natural Resources Canada, Canadian Forest Service. Ottawa, Ontario. 22 pages.

District, and to allow for calculation of sampling errors for other VRI attributes. The Provincial Inventory will cover the *entire* District including the timber harvesting landbase, inoperable landbase, parks, recreation areas, ecological reserves and private lands. The key attributes of interest are stand age, net volume by species, stand height and species composition. The variability of these tree attributes will be used to set the sample size for the Provincial Inventory.

### 3.1.3 Sampling Plan

#### *3.1.3.1 Sample Size*

To achieve the inventory objectives as identified above, the sample sizes required to implement the Provincial Inventory are summarized in Table 2. In inventory, a sampling error standard is necessary to provide a basis for determining sample size. In the VRI, the allowable sampling error standard is set at ±10% for volume estimation at the Unit/District level. This standard does not apply to other attributes in the inventory.

The number of samples required to achieve the standard is a function of the variation within the inventory unit, estimated by the coefficient of variation (CV%). The estimated CV in the Chilliwack Forest District used to estimate the total number of plots to achieve a sampling error of ±10% for net volume is 55%.[4] To achieve the VRI standard at a reasonable cost, two types of VRI plots will be used:

- full VRI samples, where the full suite of information (timber, coarse woody debris, range and ecology) is collected; and
- tree emphasis samples, where only tree information is collected.

The total number of full VRI samples (55) will be adequate to achieve a sampling error of ±15% in the treed landbase. Tree emphasis samples (TEP) (65) will then be used to reduce the sampling error in the treed landbase to ±10% to achieve the standard.

In the remaining non treed area of the unit, the number of full VRI samples established will be the ratio of the treed to remaining landbase, multiplied by the number of treed VRI samples required to achieve a sampling error of ±15% (40).

Implementing the two types of samples will ensure a minimum number of full VRI plots are established across the landscape to collect the full suite of VRI information. Establishing TEPs to boost the number of plots required to achieve the VRI standard will result in saved time and money.

To complete the Provincial Inventory, NVAF (net volume adjustment factor) and WPV (within polygon variation) sampling is required. The numbers of these types of samples are contained in Table 2.

Table 2. The estimated sample size required to implement the Provincial Inventory.

[4] The inventory audit CV was inflated by 25% to account for the possible differences between the CV estimates based on the VRI design (a tight 5-plot cluster) and based on the inventory audit (a well-distributed 9-plot cluster).

| Ground Sampling Activity | Sampling Unit | VRI Samples | Tree Emphasis Samples | Sample Size |
|---|---|---|---|---|
| Provincial Inventory | | | | |
| Vegetated Treed | Cluster | 55 | 65 | 120 |
| Other | Cluster | 40 | - | 40 |
| Net Volume Adjustment Factor | Tree | 75 | | 75 |
| Within Polygon Variation | Polygon | 30 | | 30 |

#### *3.1.3.2 Provincial Inventory Sampling*

To achieve the Provincial Inventory objective, the sampling should be implemented in a two-step process. Step 1 is to install approximately 90 sample clusters in the first field season over the entire District. Step 2 is to install the remaining sample clusters in the second field season. The sampling locations will be selected systematically from the sorted list of potential sampling points. This list will include all polygons in the District and will be sorted by non-vegetated/vegetated and then land type, leading tree species, age, and site index. Sampling in the first year will provide experience to refine the process for the second field season, and information to calculate precisely the remaining number of samples required to meet the precision target of ±10% for total net volume in the treed portion of the District. An estimated total of 160 sample clusters will be assumed for planning, training, and other logistic considerations. Matching unavailable sampling sites with sub-sampling of sample clusters with difficult access will be anticipated and planned for, as these activities will increase inventory costs.

A two-step approach should also be used for implementing the other ground sampling activities that support the Provincial Inventory process: NVAF sampling and WPV sampling. NVAF provides a factor to adjust the net volume from the ground sampling (derived from the net factoring process and taper equations) to account for hidden decay and possible bias in taper equations. WPV information is used to express the total error of the inventory and to indicate accuracy of individual polygon estimates. A total of 75 sample trees for NVAF sampling (selected from 15 treed and 1 non-treed polygons) and 30 sample polygons for WPV sampling are required.

## 3.2 Management Inventory

### 3.2.1 Management Unit Landbase

For the Chilliwack Forest District, several sub-units were created to address the inventory issues raised by the stakeholders. These sub-units correspond to the timber volume in the operable landbase (the Fraser TSA, TFL 26, TFL 43, UBC Research Forest, and Seymour Demonstration Forest), second-growth stands (in the Fraser TSA and TFL 26), and vegetation within the Parks. Table 3 provides an approximation of the area to be assessed by the Provincial and the Management Inventories.

Table 3. Area by Inventory Unit within the Chilliwack Forest District

| Inventory Type | Inventory Unit | Area (ha) |
|---|---|---|
| Provincial Inventory | Forest District | 1,553,537 |
| Management Unit | | |
| Fraser TSA | Operable Landbase | Not Available |
| TFL 43 | Operable Landbase | Not Available |
| Second-growth stands | Operable Landbase | Not Available |

### 3.2.2 Objectives

#### *3.2.2.1 Photo Interpretation*

Photo interpretation work has been considered but is not recommended at this time for the Management Inventories within the Chilliwack Forest District.

#### *3.2.2.2 Ground Sampling*

The objective of the Management Inventories are to improve the inventory information of timber volumes in the timber harvesting landbase in the Fraser TSA, TFL 26, TFL 43, UBC Research Forest, and the Seymour Demonstration Forest in the GVWD. Each of these areas should be considered a separate Management Unit.

### 3.2.3 Sampling Plan

To achieve the objectives of the Management Inventories, Timber Emphasis Sampling will be required. The Timber Emphasis Sampling must meet the minimum sampling requirements as specified in *Implementation Strategy to Integrate Management, Provincial and National Inventories* (MoF, Resources Inventory Branch) The supplemental sampling will involve the installation of approximately:

- 250 sample clusters for the operable landbase of the Fraser TSA;
- 50 sample clusters for the operable landbase of TFL 43; and
- 150 sample clusters for second growth stands.

The implementation should proceed in a manner similar to the Provincial Inventory ground sampling. The sampling will be spread over a period of 2 years, with unbiased interim results expected after the first season. Sampling in the first year will provide experience to refine the process for the second field season and information to calculate precisely the remaining number of samples required to meet the precision target of ±10%.

The supplemental sampling should focus on tree attributes including call grading, net factoring and sub-sampling trees for stem analysis (addressing only decay, not breakage and waste).

NVAF sampling is not required for Management Inventories however it is strongly encouraged. Stakeholders should identify within their more detailed *Inventory Plans*[5] if NVAF sampling is to be conducted.

# 4. IMPLEMENTATION STRATEGY

The ground samples that are established to meet the Management Unit objectives are compatible with the Provincial Inventory objectives providing that these dual-purpose plots are identified prior to establishment. Therefore, Provincial Inventory plots will be identified prior to identifying the Management Unit ground sampling plots. These coincident plots will be used for both the Provincial and Management Inventories. Additional Management Inventory samples will be established to meet Management Inventory objectives. This integrated approach, that uses one set of samples to address multiple inventory needs, will result in minimum implementation costs.

There may be a need to enhance the coincident plots for non-timber attributes within the Management Units depending on the implementation strategy chosen. Additional Provincial Inventory ground samples will need to be established in the non-Management Inventory area in order to complete the Provincial Inventory for the Kamloops and Clearwater Forest Districts.

The inventory outlined above will be completed to the Ministry of Forests minimum standards as outlined in *Implementation Strategy to Integrate Management, Provincial and National Inventories*.

## 4.1 Steps

There are several ways to complete the ground sampling in the two-step process stated above. It is hoped that stakeholders will complete all the required ground sampling in a timely manner. One possible scenario is as follows:

1. Install a large number of each Management Inventory sample clusters (e.g., 100) over the entire landbase measuring *only those* tree attributes related to timber volume and site index. Install the Provincial Inventory samples for plots that are designated "multi-purpose" and install tree emphasis plots for the others. This will provide the experience to refine the process for the second field season and will provide information to calculate the required number of remaining sample clusters.
2. Install the remaining Management Inventory sample clusters in the second field season. (Note: the stakeholder may choose to install all ground samples in one field season).

[5] Inventory Plans are required by stakeholders in order to proceed with their Management Inventories.

### 4.1.2 Implementation Process

The implementation process will proceed based on available funding and can be implemented based on a number of scenarios. All implementation scenarios will a common process. One possible implementation process could proceed as follows:

1. Assemble all polygons within the District into one list; check to ensure no areas are missing or double counted.
2. Sort the polygon list according to the criteria: BC Land Cover Classification code, estimated leading tree species, age, and site index.
3. Select potential sampling points from the sorted list, as described in the Ministry of Forests, Resources Inventory Branch document *Vegetation Resources Inventory: Preparing a sampling plan for ground sampling*.
4. Stratify list to *vegetated treed* and *remaining area* (non-vegetated, vegetated non-treed).
5. Systematically select the Provincial Inventory samples by stratum.
6. Systematically select the polygons for the WPV sampling from the list of Provincial Inventory samples.
7. Systematically select the 16 NVAF sample points (15 treed and 1 non-treed whether or not volume is indicated) from the Provincial Inventory ground samples.
8. Stratify the District to determine the Provincial Inventory samples that meet Management Inventory objectives. Subtract this number of samples from the total required for each Management Inventory. Select the remaining number of Management Inventory samples.
9. For each Management Inventory, systematically select a batch of sampling points from the list of operable sampling points (80% of the sample size) and from the list of inoperable sampling points (20%).
10. Begin planning for field sampling.
11. Prepare a field sampling plan that includes sample cluster batches to ensure an unbiased sample is attained at the end of the first field season. Identify NVAF sample points and ensure they are field sampled early in the field season.
12. Locate and measure ground sample clusters.
13. Monitor quality assurance of field data and procedures during field sampling. Arrange for 'audit quality cruisers' to sample auxiliary plots of NVAF samples.
14. Compile the data in the fall and winter of the first year. This will include computing averages of timber volume, basal area, and regression of photo estimated volume to ground sample volume and the associated standard error of the regression.
15. Prepare NVAF tree sampling matrix. Begin NVAF destructive sampling.

16. Prepare for the second step during the winter. This will include calculation of the CV based on the standard error of the regression. The remaining number of samples required to achieve the stated desired precision can then be accurately determined using standard procedures (see Appendix B).
17. Prepare the remaining samples.
18. Locate and measure remaining ground sample clusters in the second field season. Complete stem analysis of the NVAF sample trees. Complete the within polygon variation sampling.
19. Compile all data, do the statistical adjustments and load final inventory results into the provincial database.

## 4.2 Cost

### 4.2.1 Provincial Inventory

The Provincial Inventory costs, for planning purposes, are summarized in Table 4.

A CV of 55% and the objective precision level of ±10% sampling error (at the 95% probability level) were used to estimate the required number of Provincial Inventory samples.

Sampling efficiency and cost effectiveness will be achieved by implementing the Management Unit sampling in combination with Provincial Inventory ground sampling. Results of the VRI ground sampling can be evaluated to determine the additional sampling required to meet the specific objectives.

The total cost could be higher or lower if the assumptions stated above are not valid. For example, an increase in the CV or a reduction in the desired precision level will result in an increase in the number of samples required to achieve the objectives. The relationship between the sampling error and sample size is illustrated in the contractor report (Appendix A).

Table 4. The estimated costs required to complete the Provincial Inventory sample plan.

| Ground Sampling Unit | Sample size | Unit Cost* ($) | Total Cost ($) |
|---|---|---|---|
| Provincial Inventory | | | |
| Sample Cluster (VRI) | 95 | 2,500 | 237,500 |
| Sample Cluster (tree only) | 65 | 1,500 | 65,000 |
| Net Volume Adjustment Factor (tree) | 75 | 500 | 37,500 |
| Within Polygon Variation | 30 | 1,500 | 45,000 |
| Total | | | 385,000 |

* The unit costs are based on experience gained from the Boston Bar Operational Trial

### 4.2.2 Management Inventory

The costs for completing the Management Inventory plan are identified in Table 5.

Table 5. The estimated costs required to complete the Management Unit sample plan.

| Ground Sampling Unit | Sample size | Unit Cost ($) | Total Cost ($) |
|---|---|---|---|
| Management Unit Sampling | | | |
| Fraser TSA | 250 | 1,500 | 375,000 |
| TFL 43 | 50 | 1,500 | 75,000 |
| Second-growth stands | 150 | 1,500 | 225,000 |
| Total | | | 675,000 |

The sample size determination for the Management Unit sampling can be found in the consultant report, *Chilliwack Forest Districts Vegetation Resources Inventory Ground Sampling Plan, Revised Final Report* (Appendix A). The required number of Management Inventory samples is based on the appropriate CV (estimated) and the objective precision level of ±10% sampling error (at the 95% probability level).

### 4.2.3 Combined Management and Provincial Inventory

Implemented separately, the total cost of the Provincial and Management Inventories would be approximately $1,060,000. Combining the inventory objectives through a common implementation strategy will realize a saving. Given the multiple Management Units within the Chilliwack Forest District and their overlapping areas, it is difficult to estimate the magnitude of these savings. However, the savings on the Provincial Inventory samples would be approximately $150,000 based on implementing all of the vegetated treed VRI and tree emphasis samples in combination with the Management Unit plots.

Table 6 illustrates the cost for one possible implementation scenario where overlap occurs between one of the Management Units and the Provincial Inventory. The total cost could be higher or lower if the assumptions stated above are not valid. For example, an increase in the CV or a reduction in the desired precision level will result in an increase in the number of samples required to achieve the objectives. The relationship between the sampling error and sample size is illustrated in the contractor report (Appendix A).

Table 6. Combined costs to complete the Management and Provincial Inventory sample plans.

| Ground Sampling Unit | Sample size | Unit Cost ($) | Total Cost ($) |
|---|---|---|---|
| Management Unit Sampling | | | |
| Fraser TSA | 250 | 1,500 | 375,000 |
| TFL 43 | 50 | 1,500 | 75,000 |
| Second-growth stands | 150 | 1,500 | 225,000 |
| Incremental Provincial Inventory Ground Samples | | | |

| | | | |
|---|---|---|---|
| Sample Cluster (upgrade to full VRI) | 55* | 1,000 | 55,000 |
| Sample Cluster (tree only) | 65* | 0 | 0 |
| Provincial Inventory (Remaining) | | | |
| Sample Cluster (VRI) | 40 | 2,500 | 100,000 |
| Sample Cluster (tree only) | 0 | 1,500 | 0 |
| Net Volume Adjustment Factor - Tree | 75 | 500 | 37,500 |
| Within Polygon Variation | 30 | 1,500 | 45,000 |
| Total | | | 912,500 |

*Tree information component to be captured as part of the Management Unit sample

The total cost could be higher or lower if the assumptions stated above are not valid. For example, an increase in the CV or a reduction in the desired precision level will result in an increase in the number of samples required to achieve the objectives. The relationship between the sampling error and sample size is illustrated in the contractor report (Appendix A).

Depending on the implementation strategy, the savings will vary. The savings realized reflect the comparative overlaps of the Management Inventories. The numbers in Table 6 reflect one possible implementation scenario. Costs will change depending on the actual implementation scenario chosen.

## 4.3 Monitoring

The Ministry of Forests, Resources Inventory Branch is responsible for monitoring this Inventory Plan.

## 5. APPROVAL/SIGNING

I have read and concur with the Chilliwack Forest District Inventory Plan, June 19, 1998. It is understood that this is an agreement-in-principle and does not commit the signatories to completing the inventory activities outlined within the plan. Modifications to this plan or more detailed plans need to be reviewed and approved by the signatories and then appended to this plan.

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District Manager
Chilliwack Forest District

_____

Regional Manager
Vancouver Forest Region

_____

Director
Resources Inventory Branch

_____

Manager
Canadian Forest Products Ltd., Chetwynd

# Appendix A

## Chilliwack Forest District
## Vegetation Resources Inventory
## Ground Sampling Plan

# Appendix B

## Polygon Selection